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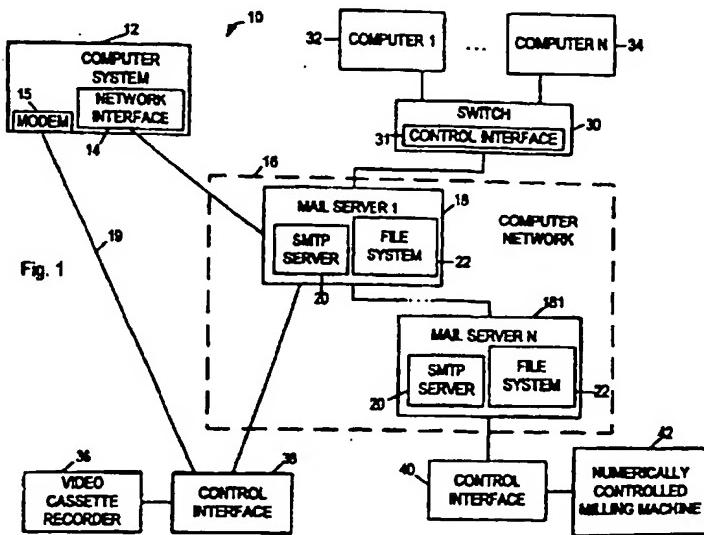
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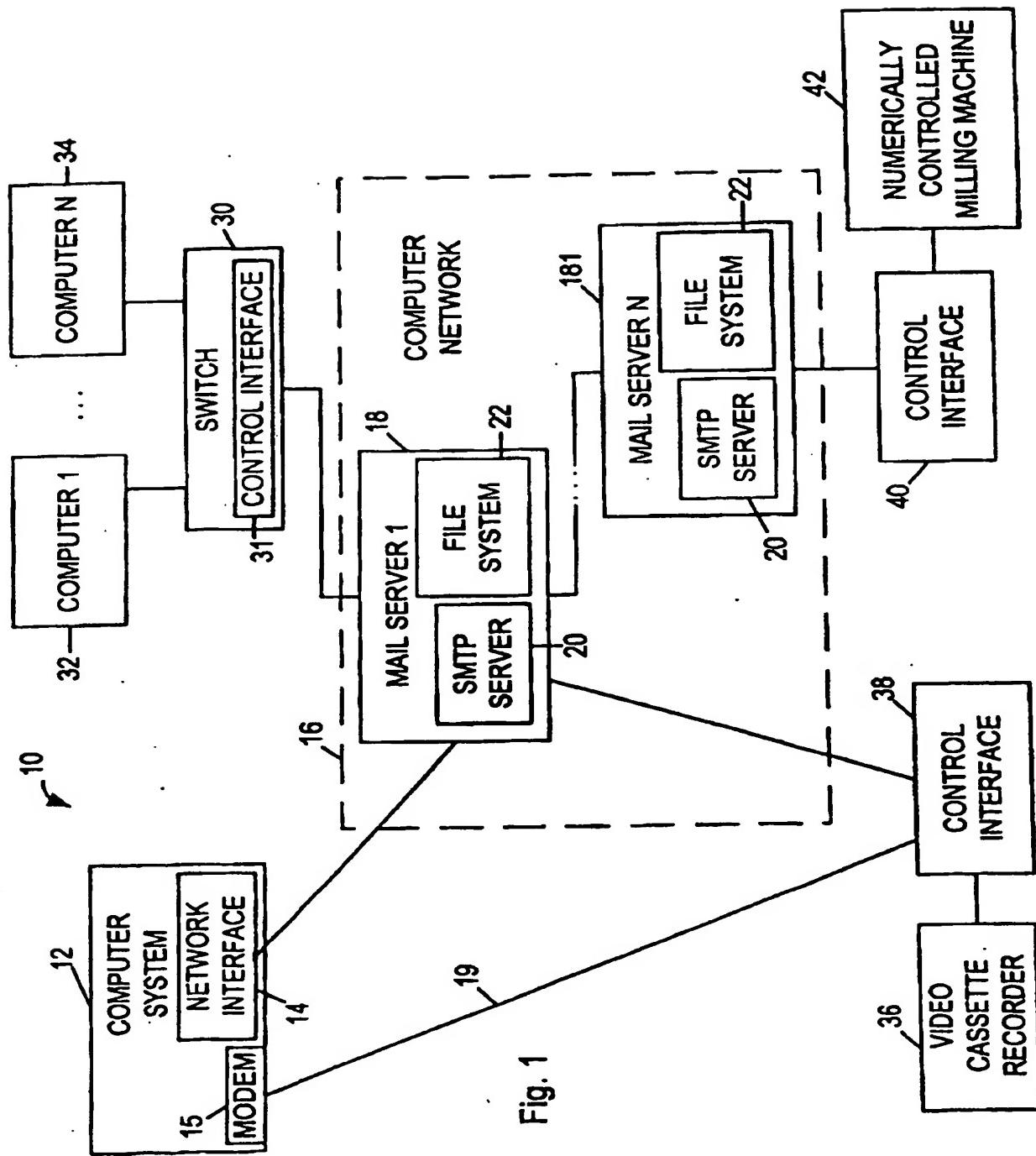
(54) Abstract Title

Remote control of devices using electronic mail

(57) Methods and apparatus for configuring, updating and/or controlling devices through the use of E-mail are described. Control and/or configuration information is incorporated into the body of an E-mail message. E-mail file attachments including, e.g., device code or software updates may also be included in the E-mail message. The E-mail message is forwarded to the device(s) to be configured or controlled via one or more E-mail servers. The device receiving the E-mail message includes an interface unit for processing the E-mail message and updating its control information, configuration information, and/or executable routines based on the message's content. The E-mail message may be sent in encrypted form making it difficult for unauthorized individuals to accomplish an unauthorized control and/or configuration modification to a device. By using an E-mail message as the data input device, the need to login and enter control and/or configuration information while being on-line can be avoided. In addition, the need to be familiar with a variety of terminal emulation routines which might be needed to login to a set of devices is reduced or eliminated. A single E-mail message may be transmitted to multiple devices which have the same configuration and/or control requirements. E-mail messages can be saved in a log, modified, and used for subsequent system updates eliminating the need to re-enter all of the control and/or configuration information. A device can respond to an E-mail message, execute routines included therein and/or send relevant status information via E-mail to a control center.



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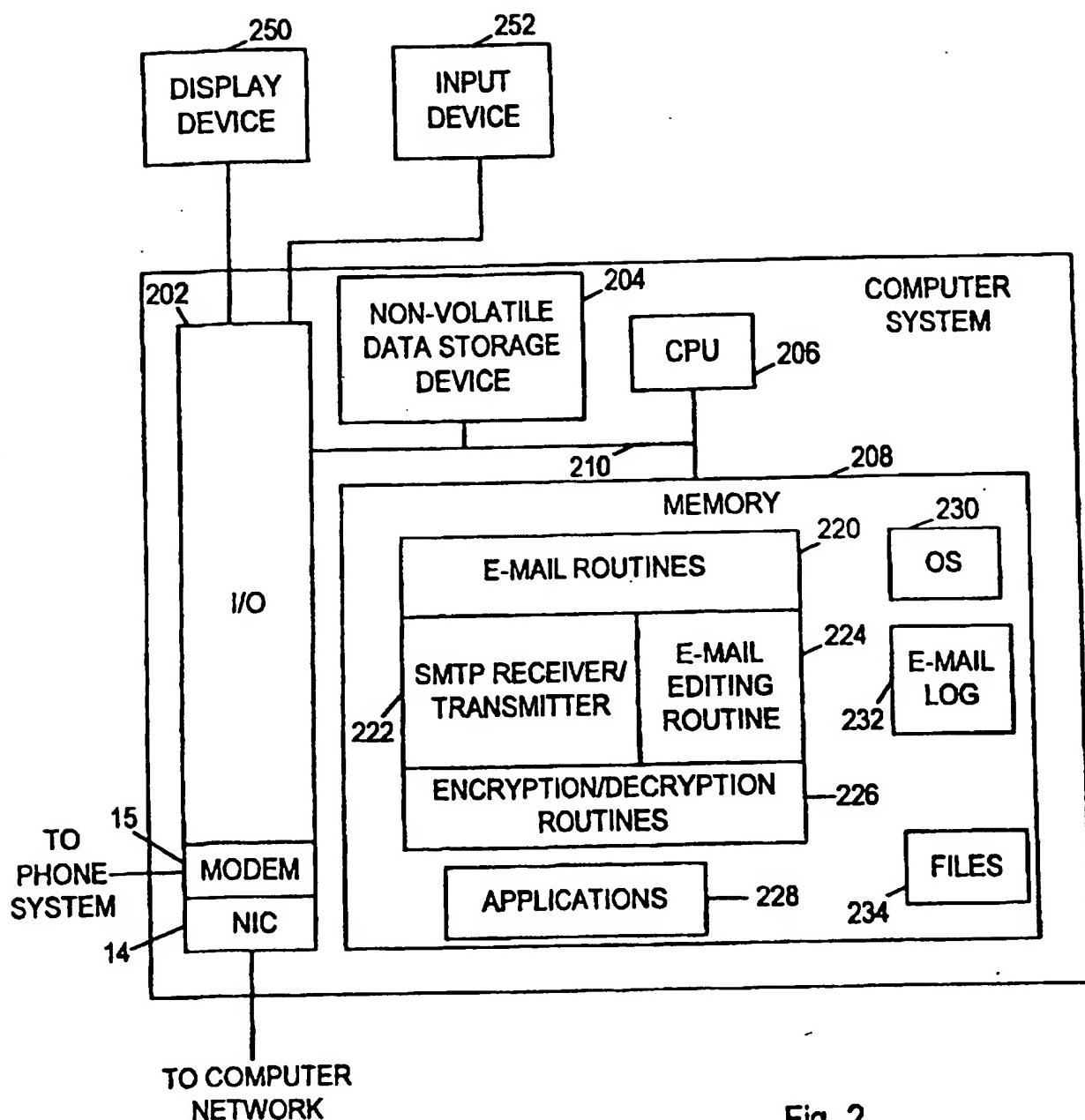


Fig. 2

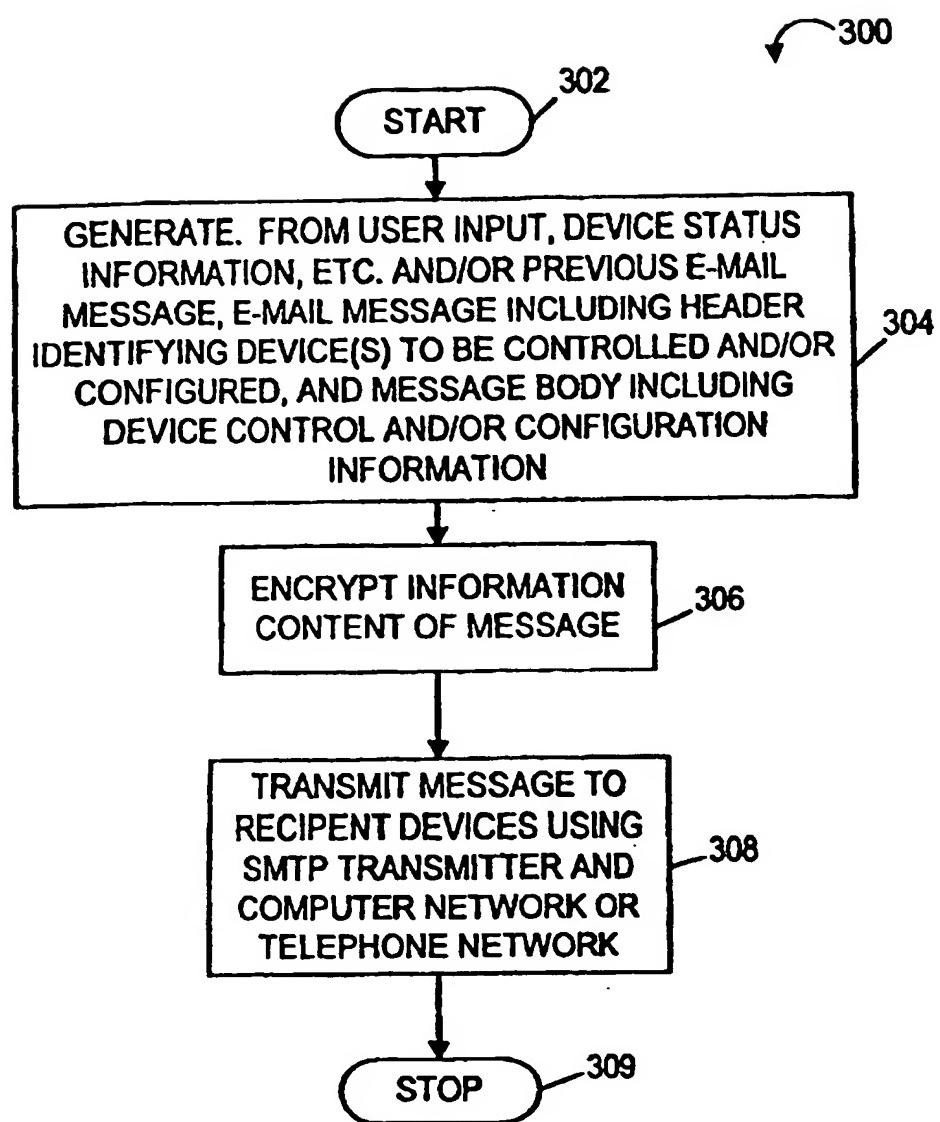


Fig. 3

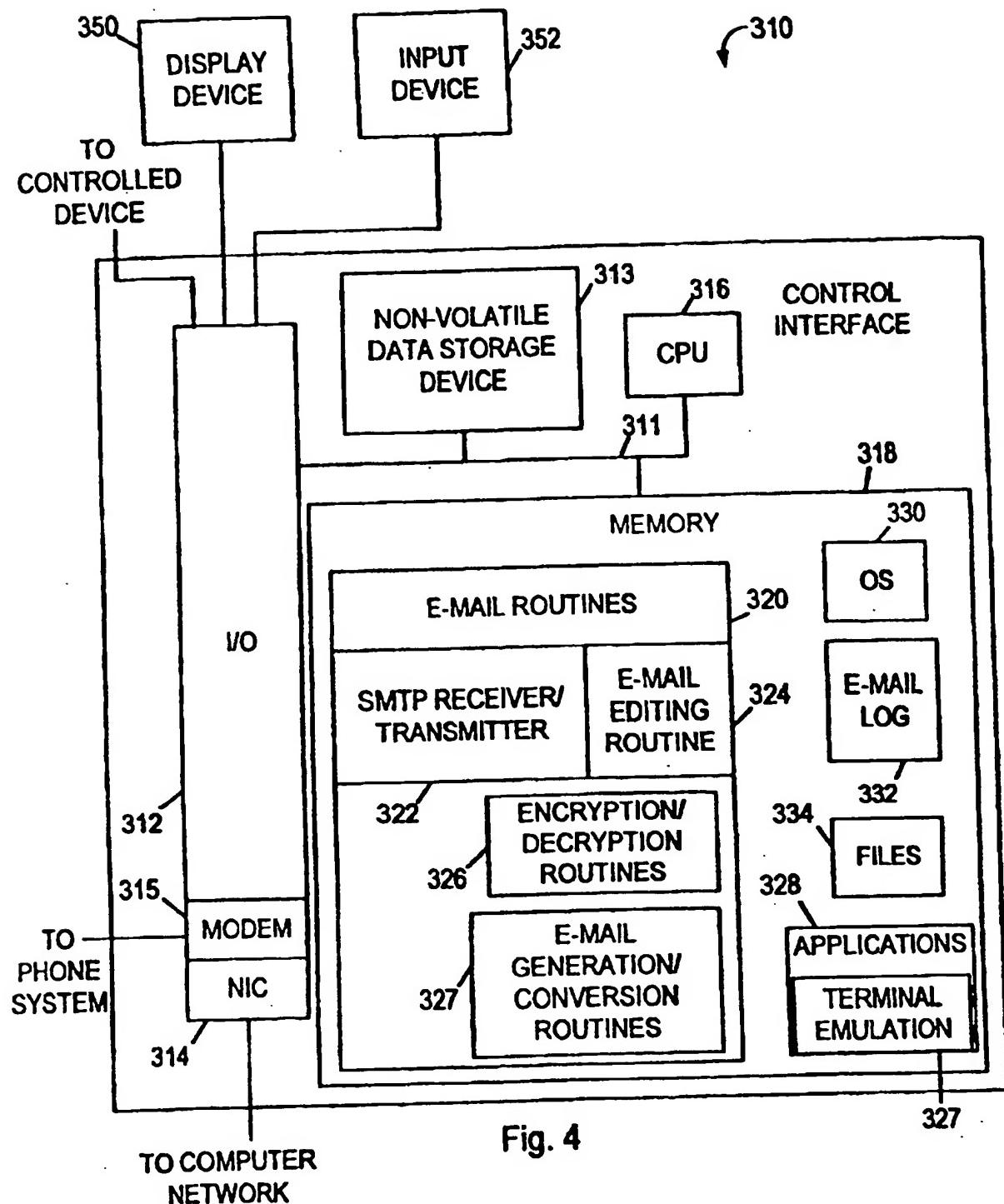


Fig. 4

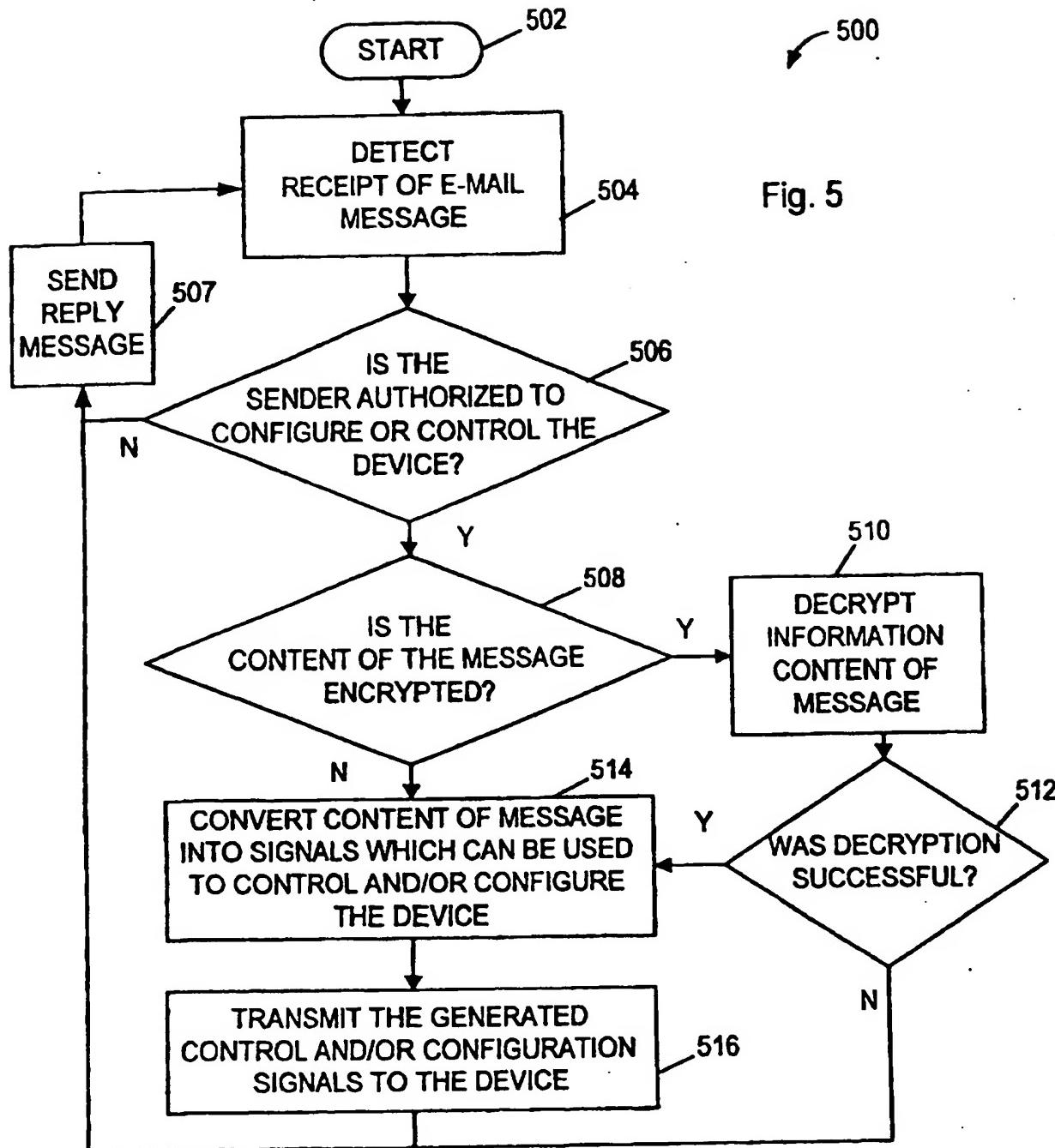


Fig. 5

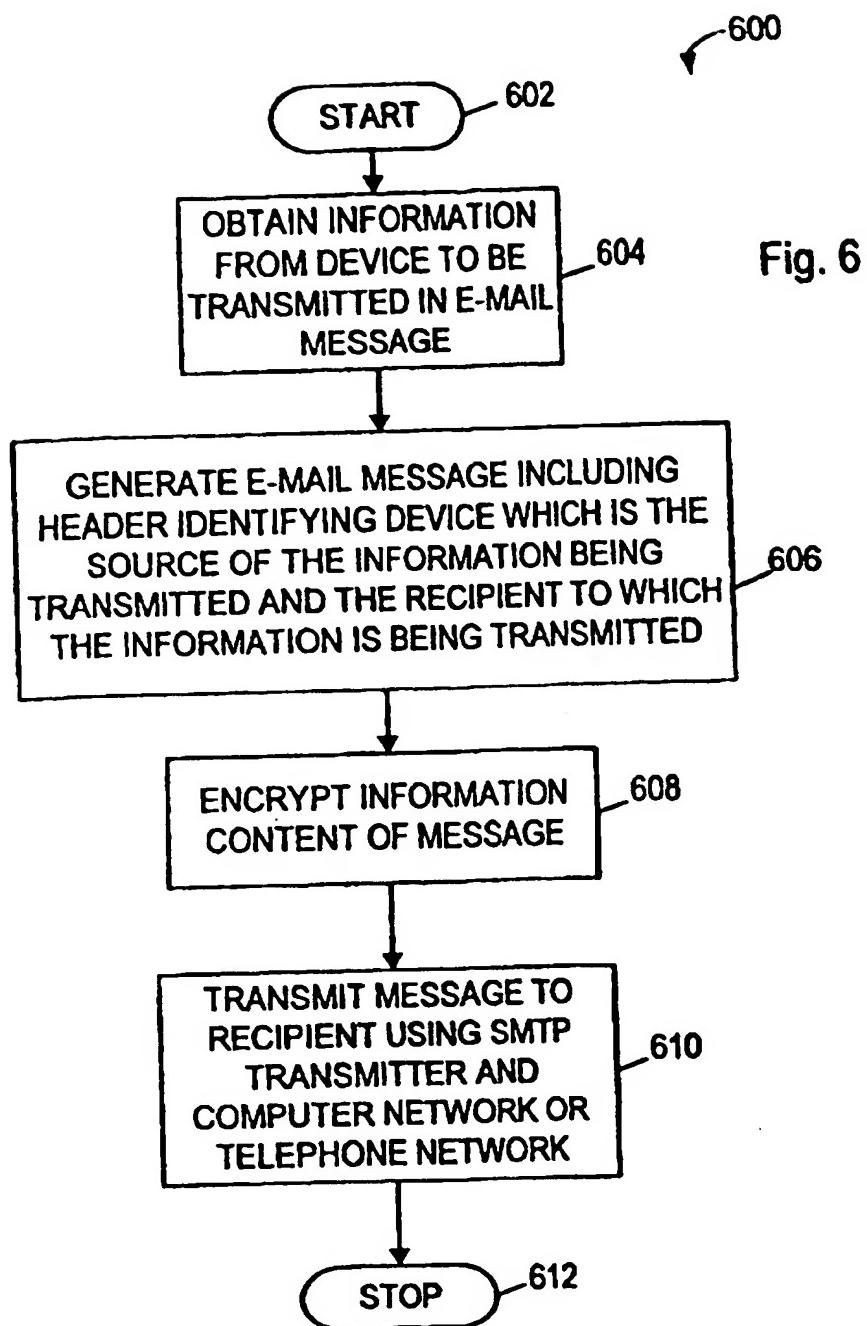


Fig. 6

700

| | | |
|----------------|---------------------------------------|-----|
| 706 → TO: | VCR@MYHOME.COM | 702 |
| 708 → FROM: | COMPUTER_SYSTEM12@CONTROL_SYSTEMS.COM | |
| 709 → CC: | | |
| 710 → SUBJECT: | RECORD PROGRAM | |
| 712 → ENCRYPT: | <u>RSA</u> | |

| | | |
|-----|-------------------------|-------|
| 716 | USERNAME :ME | 714 |
| | PASSWORD :LETMEIN | |
| | SET TAPE POSITION :0:00 | ← 718 |
| | PROGRAM MODE :RECORD | |
| | SETUP NUMBER :1 | 722 |
| | PROGRAM DATE :TODAY | |
| | PROGRAM START :17:00 | |
| | PROGRAM END :18:00 | |
| | CHANNEL :5 | |
| | ENABLE SETUP :1 | |
| | SETUP NUMBER :2 | 724 |
| | PROGRAM DATE :24/12/98 | |
| | PROGRAM START :06:00 | |
| | PROGRAM END :08:00 | |
| | CHANNEL :1 | |
| | ENABLE SETUP :2 | |
| | PROGRAM MODE :END | ← 726 |

FIG. 7

800

806 → TO: CAE_SWITCH, FINANCE_SWITCH

808 → FROM: COMPUTER_SYSTEM12@CONTROL_SYSTEMS.COM

809 → CC:

810 → SUBJECT: SWITCH CONFIGURATION SETUP

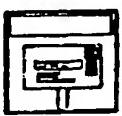
812 → ENCRYPT: RSA

LOGIN : ADMINISTRATOR } 814
 PASSWORD : ADMINISTRATOR }

IP INTERFACE BOOTP ENABLE

| ETHERNET | PORTMODE | 0 | 100 | FULL |
|----------|----------|----|-----|------|
| ETHERNET | PORTMODE | 1 | 100 | HALF |
| ETHERNET | PORTMODE | 2 | 100 | HALF |
| ETHERNET | PORTMODE | 3 | 100 | HALF |
| ETHERNET | PORTMODE | 4 | 100 | HALF |
| ETHERNET | PORTMODE | 5 | 100 | HALF |
| ETHERNET | PORTMODE | 6 | 10 | HALF |
| ETHERNET | PORTMODE | 7 | 10 | FULL |
| ETHERNET | PORTMODE | 8 | 10 | FULL |
| ETHERNET | PORTMODE | 9 | 10 | HALF |
| ETHERNET | PORTMODE | 10 | 10 | HALF |
| ETHERNET | PORTMODE | 11 | 100 | HALF |
| ETHERNET | PORTMODE | 12 | 100 | FULL |

SYSTEM SOFTWARE UPDATE ← 822



← 824

LATEST_IMAGEFILE.BIN

LOGOUT ← 826

FIG. 8

METHODS AND APPARATUS FOR EXCHANGING
CONTROL INFORMATION AND CONTROL SIGNALS
THROUGH THE USE OF E-MAIL

The present invention is directed to device control and, more particularly, to methods and apparatus for exchanging information and control signals between a control unit and one or more controlled devices.

10

The use of computer networks, and inter-connected groups of computer networks referred as intranets, continues to be on the increase. The World Wide Web (WWW), sometimes referred to as the Internet, is an example of a global system of inter-connected computer networks used for both business and personal pursuits. The increased use of intranets within individual businesses and the increased use of the Internet globally is due to the increased number of computer networks in existence and the ease with which data, e.g., messages and/or other information, can now be exchanged between computers located on inter-connected networks.

25

Electronic mail, frequently referred to as E-mail, is probably one of the most widely used services associated with computer networks. E-mail

allows different users of a system, to whom a mailbox is assigned, to exchange information in the form of a text message.

E-mail messages usually include a header and a body. The header and body may each comprise several lines of information. The header normally comprises a number of fields, e.g., a TO: field and a FROM: field. Additional fields which may be included in an E-mail header include a CC: field, a SUBJECT: field, a DATE: field; and an ENCRYPTED: field. The TO: field is normally used to identify the party, device or machine to whom the E-mail is being directed. The FROM: field is normally used to identify the sender, e.g., the party, device, or machine that is the source of the E-mail. The CC: field is used to identify additional recipients of the E-mail message. The SUBJECT: field normally includes information, e.g., text, which identifies the subject matter of the message, the DATE: field is used to indicate the date the message was transmitted. The ENCRYPTED: field is used to indicate whether or not the body of the message has been encrypted.

In addition to including text, the body of the message may include a file attachment. The attached file may be, e.g., a text file, a binary file, etc.

So that dissimilar systems are capable of exchanging E-mail messages a plurality of messaging

protocols have been adopted. SMTP, which stands for Simple Mail Transfer Protocol, is one known standard for E-mail communication.

5 In addition to providing electronic communications services, computers and computer networks are frequently used to control a wide range of devices. For example, computers, e.g., CPUs, are used to control communications devices such as mail servers, 10 milling machines, alarm systems, etc.

15 Often controlled devices require periodic configuring or re-configuring. For example, a milling machine may need to be re-programmed to mill a new product. A video cassette recorder may need to be re-programmed to record a different television show or to record the same telephone show at a different time due to a change in revision schedules. A mail server or switch may need to be reconfigured due to a change 20 in network configuration, etc.

25 The control and/or reconfiguring of computer controlled devices often involves re-entering many of the same commands originally used to configure the computer controlled device.

30 In addition to the difficulties associated with creating configuration update information and/or routines, specific knowledge of how to enter the configuration information may be required. Frequently,

the manner in which configuration information is entered varies from device to device.

One common approach to entering configuration information into a computer controlled device is to manually enter configuration commands. This may be done using an input panel or a control terminal coupled to the device. In order to facilitate such input, the control terminal may be implemented by executing a control terminal emulation routine. The emulation routine may be executed on a computer system coupled to the device to be configured.

Specific terminal commands, which may be unique to the emulated terminal used to control a device, may be required to initiate the entering of configuration and/or information. In addition, in many cases, an exact device identifier must be entered before a device will accept updated configuration information. Thus, terminal emulation software, device specific commands and device specific identifier information may have to be entered before control or configuration information will be accepted. Given the large number of different terminals used to control devices today, remembering the appropriate terminal data entry commands to be used with a specific machine can be difficult. The need to remember device specific information further complicates the process of updating computer controlled devices. For the foregoing reasons configuring and/or controlling multiple devices is

often a daunting task for many individuals not only in industry but in the consumer environment as well.

In view of the above, it becomes apparent that there is a need for improved methods and apparatus for entering control, configuration and/or update information into computer controlled devices. It is desirable that at least some of the new methods and apparatus be capable of performing the control, configuration and/or updating operations from a physically remote location to avoid the need to send an operator to the physical location of the device or devices being updated. It is also desirable that new methods and apparatus avoid the need to utilize device specific terminal emulation software to enter the control and/or configuration information. The number of device specific commands should also be avoided or kept to a minimum.

It is desirable that any new methods or apparatus for controlling and configuring devices include, or be capable of including, some security measures in order to reduce the chances of malicious entry of unauthorized control, update and/or configuration information. The ability to utilize portions of previously entered control, update and/or configuration information when entering new or updated information, without having to re-type the information is also desirable.

The present invention is directed to methods and apparatus for exchanging information and control signals between a control unit and one or more controlled devices, e.g., numerically controlled manufacturing equipment, consumer electronics devices as well as network components. The control signals may include, e.g., control commands, update signals, and device configuration signals.

The present invention uses E-mail messages to transmit control, update and/or configuration information to a device which is being controlled. Control and/or configuration information is incorporated into the body of the E-mail message. The E-mail message may be forwarded to one or more devices to be configured or controlled.

Devices of the present invention include control interfaces which are capable of decoding received E-mail messages and generating therefrom control, update and/or configuration signals which are used to control, update and/or configure the device to which the message is directed.

Devices which do not include control interfaces internally have an external control interface which is responsible for receiving E-mails directed to a device and converting them into signals which can be used by the device.

The control interface may include a terminal emulator which emulates a control terminal into which control instructions received via E-mail can, and in various embodiments are, entered.

5

In accordance with the present invention E-mail messages may be sent in encrypted form making it difficult for unauthorized individuals to accomplish an unauthorized control and/or configuration modification 10 to a device.

10

By using an E-mail message as the data input device, the need to login and enter control and/or configuration information while being on-line can be avoided. In addition, the need to be familiar with a variety of terminal emulation routines which might be needed to login to a set of devices is reduced or 15 eliminated.

20

A single E-mail message may be transmitted to multiple devices which have the same configuration and/or control requirements. In addition, the methods and apparatus of the present invention allow E-mail messages to be saved in a log, modified, and used for 25 subsequent system updates eliminating the need to re-enter all of the control and/or configuration information.

25

Device updates, commands and/or software may 30 be transmitted to a device as file attachments which are included in E-mail messages of the present

invention. A command included in the E-mail message can be used to cause the device to execute the command upon receipt of the E-mail message.

Because E-mail messages can be transmitted via computer networks and telephone lines, the control system used to generate an E-mail message in accordance with the present invention can be geographically located a great distance away from the device which is being controlled, e.g., several or even thousands of miles away.

A device can respond and/or send relevant status or other information via E-mail to a control center or designated individual in accordance with the present invention. The control center can then schedule maintenance or transmit device control, configuration and/or update E-mail messages to the device in response to the status information.

Preferred features of the present invention will now be described, purely by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a block diagram of system implemented in accordance with an exemplary embodiment of the present invention.

Figure 2 illustrates a computer system implemented in accordance with the present invention.

5 Figure 3 is a flow chart illustrating the operation of a computer system when generating and transmitting E-mail messages including control, update and/or configuration information in accordance with the present invention.

10 Figure 4 illustrates a control interface implemented in accordance with the present invention.

15 Figures 5 and 6 are flow charts illustrating operation of a control device in accordance with the present invention.

20 Figures 7 and 8 illustrate exemplary control, update and/or configuration E-mail messages implemented in accordance with the present invention.

As discussed above, the present invention relates to methods and apparatus controlling, updating and configuring devices, e.g., numerically controlled manufacturing equipment, consumer electronics devices as well as network components. In accordance with the present invention, E-mail messages including control, update and/or configuration information are transmitted from a computer system to a device which is to be controlled, updated or configured. The computer system

is used to create, e.g., compose and store, the E-mail messages addressed to the controlled device or a control interface coupled thereto.

Fig. 1 illustrates a system 10 implemented in accordance with the present invention. The system 10 comprises a computer system 12 for generating E-mail messages including device control and/or configuration information, a plurality of controlled devices 36, 42, 30 and a computer network 16 for transmitting E-mail messages between the computer system 12 and the devices 36, 42, 30. In the Fig. 1 embodiment, the controlled devices include a video cassette recorder 36, a numerically controlled milling machine 42, and a switch 30.

Video cassette recorder 36 is coupled to the computer system 12 via control interface 38 and computer network 16. The recorder 36 is also coupled to the computer system 12 via the control interface 38 and a dial up connection, telephone line 19, established via a public telephone switching network represented by line 19. Thus, video cassette recorder 36 and computer system 12 can exchange control, update, configuration and status information via E-mail messages transmitted over the computer network 16 or telephone network 19.

Numerically controlled milling machine 42 is coupled to the computer system 12 via control interface 40 and the computer network 16. Thus,

numerically controlled milling machine 42 can communicate with the computer system 12 via E-mail messages exchanged between the control interface 40 and the computer system 12 over the network 16.

5 Control interfaces 38 and 40 are illustrated in Fig. 1 as being located external to the video cassette recorder 36 and numerically controlled milling machine 42. Use of an external control interface 36, 10 40 may be desirable when interfacing with existing equipment which is not capable of directly generating or receiving E-mail messages. However, it is contemplated that the control interfaces of the present invention may, and in many cases will be, incorporated 15 directly into the controlled devices 36 and 42. Such an approach eliminates the need for an external control interface. In many cases, a more cost effective embodiment can be achieved by incorporating the control interface directly into the controlled device as 20 opposed to implementing the controlled device and control interface as separate circuits.

The switch 30 is a device wherein a control interface 31 of the present invention is incorporated 25 directly into the controlled device 30. By incorporating the control interface 31 directly into the switch 30, memory, CPU and I/O circuitry used to implement the control interface 31 can also be used to perform normal switch functions. As is known in the 30 art, multiple computer systems may be coupled to a switch. The switch 30 has computer systems 32, 34

coupled to it. The switch 30 can route signals between computer systems 32, 34 and other computer systems and/or devices coupled to the computer network 16.

The computer network 16 is representative of various computer networks which support E-mail services. The computer network 16 comprises a plurality of first through N^{th} mail servers 18, 18'. E-mail messages may be passed through multiple mail servers 18, 18' before reaching the designated recipient. Each of the mail servers 18, 18' includes a simple mail transfer protocol (SMTP) server 20 and a file system 22. The file system 22 is used, e.g., for temporarily storing E-mail messages which are being transmitted over the network 16. While the present invention is described in the context of a system which uses the SMTP protocol for E-mail, it is to be understood that the invention is not limited to an SMTP embodiment but can be used with any of a wide variety of E-mail systems and protocols.

In the Fig. 1 embodiment, the VCR control interface 38 and the switch's control interface 31, are both coupled to the first mail server 18. However, the milling machine's control interface 40 is coupled to the N^{th} mail server 181.

Fig. 2 illustrates the computer system 12 in greater detail. The computer system 12 comprises a display device 250, input device 252, an input/output interface 202, a CPU 206, memory 208, a non-volatile

data storage device 204 and a bus 210. The display device 250 may be, e.g., a computer monitor. The input device 252 may be, e.g., a keyboard, mouse, or any combination of a plurality of known input devices.

5 The I/O interface 202 includes a modem 15 and a network interface card (NIC) 14. The interface 202 is responsible for electrically interfacing between the display device 250, input device 252, and the internal components of the computer assembly 200 coupled to the bus 210 as well as other devices coupled to the interface 202. The modem 15 allows the computer system 12 to transfer E-mail to, and receive E-mail from, another device or network via the public telephone network 19. The NIC 14 allows the computer system 12 to interact with the computer network 16 and the mail servers 18, 18' included therein via an Ethernet connection and/or one or more other types of supported network connections.

20 The non-volatile data storage device 204 may comprise, e.g., a hard disk device and/or a ROM. The data storage device 204 is used for storing files, applications, and other routines, such as those discussed below in regard to the contents of the memory 208. Because the storage device 204 is non-volatile, the contents of the storage device remain intact even when power to the computer system 200 is turned off.

During operation, applications and routines executed by the CPU 206 are stored in random access memory (RAM), e.g., the memory 208. The memory 208 includes a set of E-mail routines 220, an operating system (OS) routine 230, and a set of applications 228, an E-mail log 232 and files 234.

The E-mail routines 220 include SMTP receiver/transmitter routines 222, an E-mail editing routine 224, and encryption/decryption routines 226. The SMTP receiver/transmitter routines 222 allow the computer system 12 to receive and transmit E-mail using the SMTP. The E-mail editing routine 224 allows a user of the system 12 to create and modify E-mail messages using the input device 252 and display device 250. Encryption/decryption routines 226 allow the user of the computer system to encrypt the body of an E-mail message and to decrypt the content of received E-mail messages.

The E-mail log 232 is a log of created, transmitted and/or received E-mail messages. The E-mail log 232 may be accessed using the E-mail editing routine 224. The log 232 allows previous E-mails, including device control and/or configuration information, to be used in generating new configuration and control E-mails. A copy of the log 232 is maintained in the non-volatile storage device 204.

One or more of the files 234 may be incorporated into an E-mail message as an attachment.

In accordance with the present invention one or more files may be used to store device configuration information which is transmitted to a device in the form of an E-mail attachment. E-mail attachments may also be used to transmit configuration, control routine and/or software updates to a device. The transmitted software updates may be executable code that the device uses to perform one or more of its routine functions.

The operating system 230 is responsible for controlling the general operation of the computer system 12. Applications 228 may include a word processor, a spreadsheet and a variety of other applications commonly found on computer systems.

Fig. 3 illustrates the steps 300 associated with generating and transmitting an E-mail message used to control a device in accordance with the present invention. The steps are performed by, or with the aid of, the various components of the computer system 12.

The process begins with a system user or application, in START step 302, initiating the generation of an E-mail message which will be used to control, update or configure a device. In step 304, an E-mail message is generated from user input, device status information, and/or one or more previous E-mail messages. The generated E-mail message includes a header identifying the intended message recipient(s), e.g., one or more devices to be controlled and/or configured, and a message body including device control

and/or configuration information. The generated header may also include information identifying the transmitting system so that replay E-mail messages can be received from the devices to which the message is being sent.

Once created, the body of the E-mail message is encrypted in step 306. After encryption of the message body, the E-mail message is transmitted in step 308 to the intended recipient or recipients using the available telephone or computer networks, e.g., computer network 16. As will be discussed below, the E-mail message directed to a device or control interface associated with a device to which the message relates.

Fig. 4 illustrates a control interface 310 implemented in accordance with one embodiment of the present invention. The interface 310 may be used as any one of the control interfaces 31, 38, 40. Much of the circuitry included in the control interface 310 is the same as, or similar to, circuitry already described with regard to Fig. 2. Accordingly, for the purposes of brevity, circuitry that is similar to the circuitry that has already been described will only briefly be discussed in regard to Fig. 4.

The control interface 310 comprises an I/O interface 312, a CPU 316, memory 318, a non-volatile data storage device 313 and a bus 311. An optional display device 350 and input device 352 are illustrated

as being coupled to the I/O interface 312. The I/O
interface 312 includes a modem 315 and a network
interface card (NIC) 314. The I/O interface 312 is
responsible for electrically interfacing between the
5 display device 350, input device 352, and the internal
components of the control interface 318. The modem 315
allows the control interface 318 to transfer E-mail to,
and receive E-mail from, another device or network via
the public telephone network 19. The NIC 314 allows
10 the control interface 310 to interact with the computer
network 16 and to receive E-mails from computer systems
and devices coupled thereto.

In cases where the control interface 310 is
15 implemented as an external device, the device to be
controlled, e.g., the video cassette recorder 36 or
milling machine 42, is coupled to the control
interface 38 via I/O interface 312. In cases where the
control interface 310 is implemented as an internal
20 device, the I/O interface and/or bus 311 can be used to
couple the control interface to other components of the
device which is to be controlled, updated or
configured.

Via its connection to the device or the
25 devices components the control interface can receive
device status information. Such status information can
be put into an E-mail message and transmitted to the
computer system 12.

The control interface's memory includes E-mail routines 320, an operating system routine 330, an E-mail log 232, files 334 and application routines 328. In the case of a control interface, application routines 328 will normally be limited to those needed to perform control and interface functions, e.g., generate E-mails of status information and so forth.

The E-mail routines 320 include SMTP receiver/transmitter routines 322, E-mail editing routine 324, and encryption/decryption routines 326. In addition to these routines which are the same as or similar to those discussed in regard to Fig. 2, the control interface 310 includes an E-mail generation/conversion routine 327.

The E-mail generation/conversion routine 327 is responsible for processing the contents of E-mail messages. This is done after the contents are decrypted in the case of an encrypted transmission. The E-mail generation/conversion routine 327 converts the E-mail contents into a form which can be used as input to the device or a component of the device being controlled, updated and/or configured. In the case of a milling machine control device, this may involve converting the E-mail contents into signals that would normally be output by a terminal emulation routine used to control the milling machine.

The E-mail conversion routine 327 is also responsible for converting signals, e.g., status information received from a device which is coupled thereto, into an E-mail message to be transmitted to the computer system 12. When generating E-mail messages the conversion routine 327 adds header information as appropriate. The header information identifies the destination computer system to which the information is transmitted and the device which is the source of the information. The E-mail generation/conversion routine 327 may also call the encryption routine 326 to encrypt the contents of the E-mail message in cases where security is of concern.

Flow chart 500, of Fig. 5, illustrates the operation of the control device 38, under direction of the E-mail generation/conversion routine 327, when an E-mail message is received.

The processing illustrated in Fig. 5 is performed by the CPU 306 when the control interface 310 is activated, e.g., upon power up. From then on, it normally continues operation until the control interface is shut down, e.g., the power is turned off. Step 502 represents the start of E-mail conversion processing by the routine 327. From step 502, operation proceeds to step 504, wherein the CPU 316 and/or control interface 312 monitor for received signals to detect the receipt of an E-mail message addressed control interface or device coupled thereto. When an E-mail message addressed to the attached device

or the control interface is detected, operation
proceeds to step 506.

In step 506, the sender's name is analyzed to
determine if the sender is authorized to configure or
control the attached device. This may be done by
comparing the sender's name to a list of names of
authorized individuals maintained in a file 334. If in
step 506, it is determined that the sender of the
received message is not authorized to control or
configure the attached device operation, the message's
contents are disregarded and operation returns to
step 504 via step 507. In step 507 a reply E-mail
message is sent. In this case, it is an E-mail error
message that is sent by the control interface 310 to
the sender of the E-mail. The reply message in such a
case indicates that the sender's message is being
disregarded because the sender is not recognized as
being authorized to control or configure the device to
which the E-mail message was directed.

If in step 506, it is determined that the
sender of the E-mail message is authorized to control
or configure the device to which the message is
addressed, operation proceeds to step 508. In step 508
a determination is made as to whether or not the
message contents are encrypted. This is done by
examining the encryption field of the message header.

If in step 508 it is determined that the message's contents are not encrypted, operation proceeds directly from step 508 to step 514.

5 If, however, the received message is encrypted, operation proceeds from step 508 to step 510 wherein the message contents are decrypted in step 510. The results of the decryption operation are checked in step 512 to determine if the decryption operation was 10 successful.

15 If the decryption of the message was successful, operation proceeds from step 512 to step 514. However, if it was unsuccessful, operation proceeds to step 504, via replay message step 507. In such a case, the reply message indicates that the recipient was unable to decode the message and is therefor disregarding the message's contents. If 20 however, in step 512 it is determined that the E-mail message was successfully decrypted, operation proceeds from step 512 to step 514 wherein the message contents are processed.

25 In step 514, the contents of the received E-mail message are processed to convert them into signals which can be used to control, configure and/or update the device to which the message was directed. This may involve the CPU invoking a terminal emulation application included in the set of applications 328 or 30 doing other types of data processing. Thus, the

contents of the E-mail message may be used as the input to a terminal emulation routine 327.

With the contents of the E-mail message in a signal format which can be used to control and/or configure the device to which the message is directed, the signals generated from the E-mail message are transmitted by the control device to the device which is being controlled, configured and/or updated. The device is then operated, e.g., to perform a physical operation such as switching, recording, and/or milling in accordance with the received signals. In this manner, device control and/or configuration is performed through the use of an E-mail message.

With the control, updating and/or configuration of the device completed, operation proceeds from step 516, via step 507, to step 504. In this case, in step 507, a reply message indicating the successful processing of the E-mail message is transmitted to the source of the message.

In addition to processing received E-mail messages directed to, e.g., a device attached to the control interface 310, the control interface 310 may generate and transmit E-mail messages, e.g., device status messages or service requests.

In accordance with the present invention control interfaces are capable of generating E-mail messages as well as receiving them. E-mail messages

are used to report, e.g., to the computer system 12 on the status of devices. In this manner, a device, via an E-mail message generated by the control interface coupled thereto, can transmit information regarding the devices operation, detected device fault conditions, and/or the need for device servicing.

Fig. 6 is a flow chart illustrating the operation of the control interface 310 under direction of an E-mail generation and transmission portion of the E-mail generation/conversion routines 327. The routine 600 may be used to generate and transmit E-mail messages indicating device status. The routine 600, is executed periodically or in response to signals received from a device coupled to the control interface.

The routine 600 begins in step 602 with the execution of the routine by the control interface's CPU 306. Operation proceeds from the start step 602 to step 604 wherein information, e.g., status information, from the device coupled to the control interface is obtained. Next, in step 606 an E-mail message is generated. The E-mail message includes a header which identifies the device which is the source of the information being transmitted, and also identifies the recipient, e.g., the computer system 12, to which the message is being directed. The message also includes in its body, the actual device status or other information which is to be transmitted.

Once the E-mail message is created, in step 608, the body of the E-mail message is encrypted. This is done both to protect the content from being interpreted by unauthorized individuals and to provide evidence of the message's authenticity to the receiving device.

After encryption, in step 610, the E-mail message including device status information is transmitted to the intended recipient using, in the exemplary embodiment, an SMTP transmitter and a computer or telephone network. With the E-mail message transmitted, operation proceeds to step 612 wherein the E-mail generating routine 600 is stopped pending its re-execution.

In response to an E-mail status message, a recipient may, and in various embodiments does, schedule device servicing and/or, through the use of an E-mail message directed to the device, revise the device's control and/or configuration information.

Fig. 7 illustrates an exemplary E-mail message 700, that may be used in accordance with the present invention to control the video cassette recorder 36 which, in this example, is designated the E-mail address VCR@myhome.com. As illustrated the E-mail message 700 includes a header 702 and a body 704. The header 702 includes a TO: field 706, a FROM: field 708, a cc: field 709, a SUBJECT: field 710 and an ENCRYPT: field 712. The TO: field 706 indicates

that the E-mail message 700 is directed to VCR@myhome.com, i.e., VCR 36 in this example. The From: field 708 indicates that the message is from COMPUTER_SYSTEM12@CONTROL_SYSTEMS.COM, i.e., computer system 12 in this example. The SUBJECT: field 710 indicates that the subject of the message is a record program. The ENCRYPT: field 712 indicates that RSA encryption is being used to encrypt the contents of the message body 704. RSA is one known encryption scheme, others may be used in accordance with the invention.

The body of the message 704, while shown as plain text for purposes of illustration, would actually be in encrypted form as a result of the RSA encryption. The message body 704 includes information 714 used to gain access to the VCR, and control information 716. The control information includes commands 718, 720 used to set the portion of the tape and the mode of VCR operation. The control information also includes first and second sets of recording program information 722, 724 and a setup completion command 726.

In response to signals generated by the control interface 38 as a result of receiving and processing the E-mail message 700, the VCR 36 records two programs in accordance with the first and second sets of recording information 722, 724.

Fig. 8 illustrates an exemplary E-mail message 800 used to control switch 30 identified in the E-mail by its E-mail address CAE-Switch and a second

switch identified by its E-mail address Finance_Switch. As illustrated, the E-mail message 800 includes a header 802 and a body 804. The header includes a TO: field 806, FROM: field 808, a CC: field 809, a SUBJECT: field 810 and an ENCRYPT: field 812. As with the Fig. 7 example, the message body 804 is shown as plain text for purposes of illustration but would normally be encrypted as indicated by the letters RSA in the ENCRYPT: field 812.

10 The message body includes information 814 used to gain administrator access to the switches to which the message is directed, control information 716, a software update command 822, a software update file attachment 824 and a logout command 826 which marks the completion of the switch setup operation. Note that in the Fig. 8 E-mail a file attachment is used to provide software that updates an existing routine stored in the switches to which the message is directed.

15 20 Devices, e.g., switches, milling machines, etc. which are controlled and/or have routines or software updated through the use of E-mail messages in accordance with the present invention, perform physical operations, e.g., switching operations or milling operations, in accordance with the control signals, routines and/or software supplied via the E-mail message of the present invention.

25 30 While the present invention has been described with regard to an exemplary embodiment

wherein specific exemplary devices are controlled, updated and/or configured through the use of E-mail it is to be understood that the methods and apparatus of the present invention can be applied to a wide variety of devices.

For completeness, the subject matter of the abstract is incorporated herein. Thus, in preferred embodiments, there is provided methods and apparatus for configuring, updating and/or controlling devices through the use of E-mail are described. Control and/or configuration information is incorporated into the body of an E-mail message. E-mail file attachments including, e.g., device code or software updates may also be included in the E-mail message. The E-mail message is forwarded to the device(s) to be configured or controlled via one or more E-mail servers. The device receiving the E-mail message includes an interface unit for processing the E-mail message and updating its control information, configuration information, and/or executable routines based on the message's content. The E-mail message may be sent in encrypted form making it difficult for unauthorized individuals to accomplish an unauthorized control and/or configuration modification to a device. By using an E-mail message as the data input device, the need to login and enter control and/or configuration information while being on-line can be avoided. In addition, the need to be familiar with a variety of terminal emulation routines which might be needed to login to a set of devices is reduced or eliminated. A single E-mail message may be transmitted to multiple devices which have the same configuration and/or control requirements. E-mail

messages can be saved in a log, modified, and used for subsequent system updates eliminating the need to re-enter all of the control and/or configuration information. A device can respond to an E-mail message, execute routines included therein and/or send relevant status information via E-mail to a control center.

It will be understood that the present invention has been described above purely by way of example, and modifications of detail can be made within the scope of the invention.

What is claimed is:

1 1. A method of controlling a device, the method
2 comprising the steps of:
3 generating an electronic mail message
4 addressed using a destination identifier associated
5 with said device, the electronic message including:
6 i. a header incorporating said destination
7 identifier; and
8 ii. a body, the body including device
9 control information; and
10 transmitting the electronic mail message
11 using a mail server as a function of the destination
12 identifier included in the header.

1 2. The method of claim 1, further comprising the step
2 of:
3 extracting the device control information
4 from the body of the electronic mail message; and
5 using the device control information to
6 control said device.

1 3. The method of claim 1 or 2, wherein the step of
2 generating an electronic mail message includes the step
3 of:
4 incorporating device login information used
5 to login on the device being controlled.

1 4. The method of claim 3, wherein the step of
2 generating an electronic mail message includes the step
3 of:

4 incorporating into the body of the electronic
5 mail message password information needed to login to
6 the device being controlled when said login information
7 is used.

1 5. The method of claim 4, wherein the login
2 information includes a user name.

1 6. The method of any of claims 3 to 5, wherein the step
2 of generating an electronic mail message includes the step
3 of:

4 incorporating device logout information used
5 to logout of the device being controlled.

1 7. The method of claim 6, wherein the device login
2 and logout information are used to emulate a terminal
3 session with the device being controlled.

1 8. The method of any of claims 3 to 7, wherein the step
2 of generating an electronic mail message includes the step
3 of:

4 incorporating into the electronic mail
5 message a software file as an attachment, the software
6 file including executable instructions used to control
7 said device.

1 9. The method of claim 8, further comprising the step
2 of:

3 operating the device to load and execute the
4 instructions included in the software file in response
5 to receipt of said E-mail message.

1 10. The method of claim 9, further comprising the step
2 of:

3 operating the device to perform a physical
4 operation in response to said instructions included in
5 the software file.

1 11. The method of claim 10, wherein the device is a
2 milling machine and said physical operation is a
3 milling operation.

1 12. The method of claim 10, wherein the device is a
2 switch and said physical operation is a switching
3 operation.

1 13. The method of any of claims 2 to 12, further comprising
2 the step of:

3 encrypting the body of said electronic
4 message prior to performing the transmitting step.

1 14. The method of any of claims 2 to 13, wherein the step of
2 transmitting the electronic message includes the step
3 of using an SMTP transmitter and a computer network to
4 transmit said electronic mail message.

1 15. The method of any of claims 2 to 13, wherein the electronic
2 mail message is transmitted using a telephone network.

1 16. A system for controlling a device, the system
2 comprising:

3 means for generating an electronic mail
4 message addressed using a destination identifier

5 associated with said device, the electronic message
6 including:

- 7 i. a header incorporating said destination
8 identifier; and
9 ii. a body, the body including device
10 control information; and
11 means for transmitting the electronic mail
12 message using a mail server as a function of the
13 destination identifier included in the header.

1 17. The system of claim 16, wherein the means for
2 transmitting includes and STMP mail server.

1 18. The system of claim 16 or 17, further comprising:
2 a device interface for receiving mail
3 messages including said destination identifier and for
4 converting the body of said messages into control
5 signals used to control said device.

1 19. The system of claim 18, wherein said means for
2 generating an electronic mail message includes:
3 means for incorporating login and logout
4 information into the body of said electronic mail
5 message.

1 20. The system of claim 19, further comprising:
2 means for encrypting the body of the
3 electronic mail message prior to the message being
4 transmitted; and
5 wherein the device interface includes means
6 for decrypting the body of the electronic mail message.

21. The system of any of claims 16 to 21, further comprising:
a device interface for receiving mail messages
including said destination identifier and for converting the
body of said messages into signals which emulate a terminal
session with said device.
22. A method substantially as described with reference to
Figures 3, 5 and 6 of the accompanying drawings.
23. Apparatus substantially as described with reference to
and as illustrated in the accompanying drawings.



Application No: GB 9910103.2
Claims searched: 1-23

Examiner: Steven Davies
Date of search: 19 October 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.Q): G3N NGBD ; H4P PPG

Int CI (Ed.6): G06F 17/60 ; H04L 12/58 ; H04M 11/00 ; H04Q 9/00

Other: Online databases: WPI, EPODOC, JAPIO

Documents considered to be relevant:

| Category | Identity of document and relevant passage | | Relevant to claims |
|----------|---|--|--------------------|
| A | GB 2208553 A | (RENISHAW) e.g. Figure 1 | |
| X | JP100261251 A | (SONY) see online abstracts | 1-21 |
| X | JP 100247345 A | (BROTHER KOGYO KK) see online abstracts | 1-21 |
| A | US 5414756 | (LEVINE) e.g. column 2, lines 6-68 | |

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